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The effect of different foodplants on cocoon crop performance in the Indian tasar silkworm *Antheraea mylitta* Drury (Lepidoptera: Saturniidae)

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Abstract. Cocoon crop performance through seasonal rearings of *Antheraea Mylitta* Drury larva on three primary foodplants Asan (*Terminalia tomentosa* W. & A.), Arjun (*Terminalia arjuna* W. & A.), Sal (*Shorea robusta* Gaertn.) and three secondary foodplants, Ber (*Ziziphus jujuba* Gaertn.), Sidha (*Lagerstroemia parviflora* Roxb.) and Dha (*Anoegeissus latifolia* Wall.) indicate better performance in winter crops than those of a rainy and autumn season. Sal, among primary foodplants, appeared uneconomical in terms of total cocoon shell (raw silk) production in spite of a superior cocoon formation Overall performance was superior in Asan than all other foodplants during all the seasons. Performance on Ber was higher than Sal and other secondary foodplants, a situation not heretofore documented. The gradation of foodplant with regard to performance (total raw silk production) was, in decreasing order of productivity: Asan, Arjun, Ber, Sal, Sidha, Dha.

Introduction

Antheraea mylitta Drury is a semidomesticated Indian tasar silkworm exploited commercially for production of tasar silk. At lower altitudes (50-30m ASL), it is trivoltine, reared three times a year in July-August (Rainy cocoon crop), September-October (Autumn cocoon crop) and November-December (Winter cocoon crop). The silkworm is polyphagous feeding on a number of foodplants, of which Asan (*Terminalia tomentosa* W. & A.), Arjun (*Terminalia arjuna* W. & A.) and Sal (*Shorea robusta* Gaertn.) are considered primary and the remainder secondary foodplants (Jolly, 1966; Jolly *et al*, 1974). Evaluation of these foodplants with respect to seasonal cocoon crop productivity has not been made. This paper evaluates tasar silk production by *A. mylitta* fed on six foodplants.

Material and Methods

At the State Tasar Research Farm (Area 20 ha) Durgapur, Orissa, a number of foodplants were selected at random for rearing of *A. mylitta* larva. The three Combretaceae foodplants chosen were Asan (*T. tomentosa*), Arjun (*T. arjuna*), and Dha (*Anoegeissus latifolia* Wall.). One foodplant from the Dipterocarpaceae, Sal (*S. robusta*) was selected as well as one Melostomaceae, Ber (*Ziziphus jujuba* Gaertn.), and one Lythraceae, Sidha (*Lagerstroemia parviflora* Roxb.). For each foodplant species, 10000 freshly hatched healthy hatchlings were separated into five groups of equal size and brushed onto a number of plants for each of three seasons. The cocoon crop performance was evaluated by effective rate of rearing

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(ERR% = 100 × total cocoons yielded / total larvae brushed), cocoon weight, pupa weight, and shell weight. These parameters were evaluated for each category of food plant in different rearing seasons by standard laboratory techniques. The data were statistically analyzed following Sokal & Rohlf (1969). The experiment was repeated yearly from 1985 to 1989 for all three rearing seasons.

Results

Table 1 presents data on cocoon crop performances on six foodplants. Crop performance as weight of cocoon, pupa and shell on all foodplants was uniformly highest in winter, followed by autumn, with rainy season last, except Sal reared autumn pupa that had the lowest weight. The ERR% on different foodplants was highest in winter and lowest in autumn, except Sal. The maximum ERR% was during rainy and minimum in winter crops).

Table 1. Cocoon crop performance in rearing of *A. mylitta* on different foodplants during Rainy (R), Autumn (A) and Winter (W) seasons (Mean ± Standard Deviation).

Food Plants	Rearing Season	ERR (%)	Cocoon weight (gm)	Pupa weight (gm)	Shell weight (gm)
Asan	R	34.05 ± 0.32	10.85 ± 0.23	9.72 ± 0.21	1.13 ± 0.03
(*T. tomentosa*)	A	26.52 ± 1.11	12.84 ± 0.30	11.40 ± 0.30	1.44 ± 0.03
	W	46.11 ± 1.85	14.35 ± 0.19	12.59 ± 0.48	1.96 ± 0.02
Arjun	R	15.45 ± 1.58	12.38 ± 0.35	10.93 ± 0.33	1.44 ± 0.03
(*T. arjuna*)	A	23.02 ± 1.10	11.46 ± 0.36	10.24 ± 0.37	1.22 ± 0.12
	W	42.21 ± 0.72	13.54 ± 0.31	11.95 ± 0.35	1.58 ± 0.08
Sal	R	15.45 ± 1.58	12.38 ± 0.35	10.93 ± 0.33	1.44 ± 0.03
(*S. Robusta*)	A	9.43 ± 0.70	12.46 ± 0.25	10.84 ± 0.60	1.62 ± 0.05
	W	7.52 ± 0.51	13.72 ± 0.25	11.92 ± 0.26	1.79 ± 0.02
Ber	R	23.01 ± 1.34	9.83 ± 0.37	8.87 ± 0.37	0.95 ± 0.01
(*Z. jujuba*)	A	18.18 ± 1.62	11.36 ± 0.21	0.22 ± 0.49	1.14 ± 0.01
	W	26.66 ± 1.48	13.26 ± 0.33	11.83 ± 0.31	1.43 ± 0.02
Sidha	R	10.59 ± 1.25	8.91 ± 0.52	8.08 ± 0.51	0.84 ± 0.01
(*L. parviflora*)	A	6.38 ± 1.08	9.75 ± 0.25	8.81 ± 0.25	0.94 ± 0.01
	W	13.07 ± 1.65	12.19 ± 0.15	11.00 ± 0.13	1.19 ± 0.03
Dha	R	5.66 ± 1.24	8.69 ± 0.38	7.95 ± 0.38	0.74 ± 0.01
(*A. latifolia*)	A	3.58 ± 0.45	9.13 ± 0.32	8.31 ± 0.32	0.81 ± 0.01
	W	8.44 ± 1.51	9.41 ± 0.39	8.55 ± 0.39	0.86 ± 0.01

Table 2. Some ecological parameters (Mean ± Standard Deviation) during rearing period of *A. mylitta*

Rearing Season	Temperature (°C)	Relative Humidity (%)	Rainfall (mm)	Stormy Weather Period (hrs.)
Rainy (July-Aug.)	31.85 ± 0.75	83.04 ± 2.22	231.29 ± 5.38	4.48 ± 1.82
Autumn (Sept.-Oct.)	28.67 ± 1.02	76.51 ± 1.79	88.97 ± 3.10	9.82 ± 3.15
Winter (Nov.-Dec.)	20.27 ± 1.04	65.39 ± 1.39	19.44 ± 2.04	0.41 ± 0.12

Table 3. Total cocoon shell (raw silk in gm) production based on effective rate of rearing (ERR × shell weight) of *A. mylitta* in different foodplant and seasons

Rearing Season	Food Plants					
	Asan	Arjun	Sal	Ber	Sidha	Dha
Rainy	38.48	31.70	22.25	21.86	8.90	4.19
Autumn	38.19	28.08	15.28	20.69	6.00	2.90
Winter	90.38	66.69	13.46	38.12	15.55	7.26

The ANOVA test on seasonal variation of all cocoon crop parameters in individual foodplants indicated significant ($P < 0.05$) differences except Dha-reared pupa weight. The t-test also indicated significant ($p < 0.05$) seasonal differences of all above crop parameters in different foodplants except Sal-reared rainy autumn cocoon weight, pupa weight and Dha-reared rainy-autumn, winter-autumn cocoon weight and winter-autumn and rainy-autumn pupa weight.

In winter Asan produced a superior crop compared with other foodplants in all parameters (Table 1). Asan reared larvae showed a significantly higher value in ERR% in all seasons, in cocoon and pupa weight during autumn and winter crop and in shell weight during the winter crop. Sal reared *A. mylitta* exhibited highest cocoon and pupa weight in rainy crop and highest shell weight in both rainy and autumn crop (Table 1). However, the total quantity of cocoon shell (raw silk) production, based on average ERR% values (ERR% × shell weight), Sal rearing was inferior to Asan and Arjun rearing in the rainy season, Asan, Arjun and Ber rearing in autumn season, and Asan, Arjun, Ber, and Sidha rearing in winter season (Table 3). Thus considering cocoon shell production in different seasons, Asan ranks first followed by Arjun and Ber (Table 3). The superiority of Sal was reflected only in production of tough, heavier cocoons, which in terms of ERR% rendered uneconomical cocoons due to poor silk productivity. Performance on so-called secondary foodplants like Ber and Sidha was higher in comparison to Sal.

The ANOVA test on foodplant variation of all cocoon crop parameters in a particular rearing season indicated significant ($p < 0.01$) difference.

The t-test also indicated significant ($p < 0.05$) foodplant differences among all cocoon crop parameters in any given season except the winter ERR% on Sal-Dha, autumn cocoon weight grown on Arjun-Ber and Asan-Sal, Winter cocoon weight on Arjun-Sal and Arjun-Ber, rainy cocoon weight on Sidha-Dha, winter pupa weight on Arjun-Sal, Arjun-Ber, Sal-Ber, rainy pupa weight on Sidha-Dha and autumn shell weight on Arjun-Ber.

There was significant interaction between different foodplant and seasonal changes for each cocoon crop parameter. It was evident from the results that winter season crops were more stable and showed higher shell productivity during trivoltine tasar silkworm rearing. Cocoon crop performances on Sal was not more profitable than Asan, Arjun and Ber due to poorer yield of raw silk. Hence the ranking of foodplant in terms of decreasing silk productivity was in the order of Asan, Arjun, Ber, Sal, Sidha, Dha.

Discussion

The superiority of the winter cocoon crop to other seasonal crops, regardless of foodplant, might be due to prevalent lower average temperature (20°C), humidity (6%) and drier atmosphere (lowest rainfall of 19 mm) which facilitates increased spinning of cocoons (Table 2). Yokoyama (1962) reported that *Bombyx mori* yields superior quality cocoons at optimum temperatures (22-23°C) and humidity (60-70%). Krishnaswami *et al.* (1973) stressed the requirement of an optimum environment for maximum productivity of good quality cocoons and comparatively drier atmosphere (60-70% RH) during spinning for better cocoon yield with *B. mori* . Sengupta (1986) remarked that larger ERR% of *A. mylitta* in winter season is due to climatic limitations.

The lowest cocoon quality during the rainy season might be due to high temperatures (31°C), RH (83%) and rainfall (231 mm) (Table 2). Ullal and Narasimhanna (1987) reported that high temperature followed by strong fluctuation results in poor quality cocoons of *B. mori*. Tanaka (1964) remarked that the rainy season is unsuitable for rearing of *B. mori* due to high RH and changing temperature. Sarkar (1980) and Anonymous (1984) stated that sudden variation in temperature is harmful to rearing *Philosamia ricini* larvae. Krishnaswami *et al.* (1973) reported that temperature and RH exceeding 20-26°C and 60-70% respectively affects cocoon quality of *B. mori*. Jolly *et al.* (1974) remarked that heavy rainfall disrupts spinning of *A. mylitta* resulting in inferior cocoons.

Although the autumn cocoon crop ranked second in quality to the winter crop, the cause of its lower ERR% compared with the rainy crop might be due to occurrence of longer stormy weather durations (9.82 hours as against 4.48 hours) during this season causing high larval mortality (Table 2). Krishnaswami *et al.* (1973) remarked about poor silk content of rainy cocoon crop and superior silk content of autumn cocoon crop of *A. mylitta*. Sengupta (1986) stated production of better quality cocoons by *A. mylitta* in September-October (Autumn).

The shell weight of Sal reared rainy and autumn crops was higher although total productivity was less (due to low ERR%). Its reason can be determined by studying nutritional values of Sal plants. Anonymous (1968), Jolly (1966) and Jolly *et al.* (1974) described superiority of Sal grown cocoons of *A. mylitta* over Asan and Arjun grown in respect of cocoon toughness and shell weight without any specific mention on their seasonal variablity, variablity of other cocoon crop parameters in different seasons, and the total productivity. Larval rearing on Ber and Sidha in winter gave higher silk productivity than Sal, although the former foodplant is described as secondary foodplant by some previous authors.

Considering overall performances, Sal's rank as a primary foodplant of *A. mylitta* is questionable. Larval rearing on Ber showed significantly ($p < 0.05$) higher ERR% and also higher silk productivity than Sal with data comparable to Asan and Arjun. Hence we suggest that Ber should be given consideration for rearing and for large scale plantation under different tasar projects involving rearing and plantation programs.

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